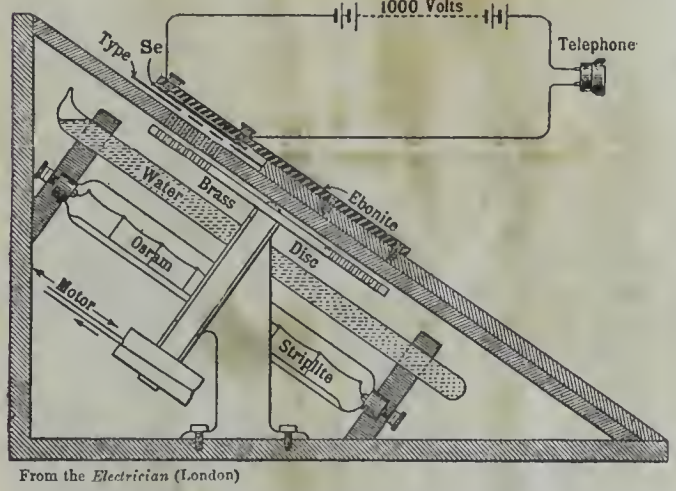
HEARING PRINT

Hearing Print

By the English Correspondent of the Scientific American

SOME time ago the SCIENTIFIC AMERICAN published an account of Dr. Fournier d'Albe's instrument for rendering differences of lighting audible. Since then the apparatus has been greatly improved and it is now possible for the blind to read by the sense of hearing, just as with the Braille type they read by the sense of touch. The apparatus by which this is accomplished is essentially an ingenious application of the fact that the substance called selenium has the peculiar property of changing its electrical resistance with changes in the intensity of the light illuminating it. If therefore this substance forms part of an apparatus (such as a Wheatstone bridge) which is so constructed that fluctuations of resistance produce electric currents, we can, by passing these currents through a telephone receiver, cause variations in intensity of illumination to produce sounds. This is the root principle of Dr. Fournier d'Albe's optophone. In the latest form of the apparatus the light used to illuminate the selenium is intermittent in character. Selenium is capable of following fluctuations in intensity of light with extreme rapidity, although in converting light oscillations into telephone sounds the higher notes would be feebler than the lower ones were it not that this tendency is largely counterbalanced by the resonance of the ear and of the telephone membrane. It is found in practice that maximum audibility occurs somewhere about a frequency of 1,000 waves per second.

The optophone used for reading purposes is illuminated by a line of light broken up into dots, the light



From the *Electrician* (London)

Diagram showing general arrangement of Dr. Fournier d'Albe's reading optophone.

of each dot being intermittent and with a frequency different to that of the others. Thus, in one apparatus actually constructed the frequencies of the eight dots composing a line eight centimeters long are in the ratio of the numbers of the diatonic scale, the eight dots forming an octave with its intermediate intervals. The actual frequencies are 24, 27, 30, 32, 36, 40, 45, 48.

By passing opaque bodies between the light and the selenium so that the dots of light are interrupted, changes of sound in the telephone are produced. Dr. Fournier d'Albe accordingly had large type printed on gelatine or other transparent material and passed between the light and the selenium. He found that the resultant sounds varied, as would be expected, with the shape of the obstruction, in this case a printed letter of the alphabet, and with a little practice the letters of the alphabet could be recognized by the ear.

The diagram shows the general arrangement of the apparatus. The line of light is furnished by an Osram "striplite" of 100 candle-power, which is concentrated by means of a cylindrical water lens upon a revolving perforated brass disk provided with eight circles with the number of holes requisite to give the eight various frequencies. The disk is spun at about 20 or 30 revolutions per second by means of an electric motor. The line of dots of eight different frequencies exists, therefore, just at the surface of the brass disk. As it is not feasible to bring the transparency to be "read" into contact with the brass disk, the luminous dots are transferred to the upper side of a wooden partition by means of a set of glass rods with flat ends embedded in the wood opposite the luminous dots. The flat ends of the rods are flush with the surface of the board, and the transparency can be safely and conveniently slid across them. The selenium bridge *Sc* is mounted above the transpareney with just sufficient clearance to allow for free displacement. The luminous dots transmitted by the type or other transparency impress their frequencies upon the selenium, and the latter gives a musical note corresponding to each dot, even when the beams of light overlap on to the same portion of the selenium. When that occurs with neighboring notes, "beats" are heard, just as they are when neighboring notes on the piano are struck together.

The selenium bridges used have a resistance of several megohms and require about 1,000 volts for the best results. The telephones used were a pair of 4,000 ohms each. Since type of any size whatever can be put into the shape of a white-on-black transpareney by means of photography, and simultaneously reduced to the proper size, the reading of type by the blind is now reduced to a matter of photography. The smallest type successfully read so far is an inch high, photographed white as a transparency. But it is quite unmistakable. The two vertical strokes of *H* or *M* give a chaos of notes, the middle stroke of *E* gives a chord, and the curved lines of *O* and *S* give characteristic flourishes of sound. Dr. Fournier d'Albe states that the alphabet of capital letters can be learnt in about an hour, and once the sounds are learnt, the process of reading may become as rapid as that of reading by sight.

As an interesting development it has been found possible to design transparencies which will give any required musical note, and a number of musical compositions have been transcribed in this manner. The notes so produced are particularly clear and free from overtones and a "musical optophone" fitted with a keyboard has been constructed.

But it is obvious that the chief desideratum is that ordinary black-on-white type, printed on paper, should be read optophonically. Experiments which have been made in this direction are very encouraging. A strip of slate long enough to cover the line of dots was cut and perforated with holes so as to let the upper ends of the glass rods project just beyond its surface. The slate was covered with selenium and sensitized. A glass plate was laid over the wooden "reading desk" and the glass rods, and a printed advertisement of large type was placed face downward on the glass. The white paper produced a chaos of all the notes, which broke up into more or less well defined notes as the black letters were passed over the rods. But the loudness and distinctness so obtainable were greatly inferior to what they are by transmitted light. Still, the solution is there in principle, and it is only a matter of making the type smaller and the effects louder and more distinct. The blind will then be able to read everything as well as the sighted.